

4. (Twice Amended) The highly permeable composite reverse osmosis membrane according to claim 1, wherein the at least one substantially monomeric compound is an acid chloride.

5. (Three Times Amended) The highly permeable composite reverse osmosis membrane according to claim 1, wherein the at least one substantially monomeric compound is at least one polyfunctional acid halide compound selected from the group consisting of aromatic, aliphatic, and alicyclic polyfunctional acid halide compounds.

Please cancel claim 7.

REMARKS

The Applicant would like to thank the Examiner for his careful review of the application. Please reconsider this application in view of the claim amendments made above and the following remarks.

I. Disposition of Claims

Claims 1 and 4-7 were pending in the application. Claim 7 has been cancelled. Claims 1 and 4-5 have been amended to clarify the scope of the Applicant's invention. No new matter has been added by way of the amendments. Support for these amendments may be found, for example, on pages 3 and 4 of Applicant's originally filed specification.

II. Claim Objections

The Examiner objected to claim 1 because the clean copy includes markings of a marked-up copy. Claim 1 has been amended as shown above. In light of this amendment, withdrawal of this objection is respectfully requested.

III. Rejections Under 35 U.S.C. § 112

The Applicant's invention relates to a highly permeable composite reverse osmosis membrane, which is prepared by cross-linking polyvinyl alcohol-based amine compounds with substantially monomeric compounds that have at least two functional groups that can react with the amino groups on the polyvinyl alcohol-based amine compounds. (Specification, p. 4, lines 6-9). Polyvinyl alcohol-based reverse osmosis membranes are known in the art. For example, published Japanese Patent Application Nos. 59-27202 and 61-17521 disclosed polyvinyl alcohol-based reverse osmosis membranes having high salt rejection efficiencies. (Specification, p. 1, lines 30-32). However, these prior art membranes have high salt rejection (e.g., > 90%) and low water permeability (e.g., < 0.2 m³/m²·d·kg/cm²). (Specification, p. 1, lines 35-36). In contrast, membranes of the present invention have low salt rejection (e.g., < 80%) and high water permeability (e.g., > 1.0 m³/m²·d at 5 kg/cm²). (Specification, p. 3, lines 26-32). When the salt rejection exceeds 80%, insoluble ingredients are easily deposited under a high recovery condition. (Specification, p. 5, lines 27-28).

Membranes of the present invention are prepared by interfacial cross-linking. In a typical reaction, a microporous support is contacted with a polyvinyl alcohol-based amine compound in a polar solvent (0.01-20% by weight) followed by an organic (non-polar) solution containing an amino-reactive compound (0.01-5% by weight). The cross-linking is typically carried out at 40-80 °C for 10 seconds to 60 minutes. (Specification, p. 6, line 37 – p. 7, line 6). Addition of a material whose solubility parameter ranges from 8 to 14 (cal/cm³)^{1/2} in the cross-linking reaction increases the water permeability of the resultant membrane. (Specification, p. 6, lines 9-11).

The Examiner rejected claims 1 and 4-7, in numbered paragraphs 3 and 4 of the Office Action, under 35 U.S.C. § 112, ¶ 2. Specifically, the Examiner rejected "(a) component as represented by Formula 1" in claim 1 as being unclear. The Examiner also rejected claims 1 and 4-7, in numbered paragraphs 6 and 7 of the Office Action, under 35 U.S.C. § 112 ¶ 1. Specifically, the Examiner rejected claim 1 because one skilled in the art would not be able to obtain the "(a) component represented by Formula 1" without undue experimentation. Claim 1 has been amended to remove the reference to Formula 1 and to more clearly define the scope of the invention. To the extent this rejection applies to the amended claims 1 and 4-6, it is respectfully traversed.

Amended claim 1 no longer includes the reference to Formula 1. It recites a composite reverse osmosis membrane comprising a polyamide thin film based on cross linking of polyvinyl alcohol-based amine compounds. It further includes "a salt rejection of no more than 80%" as a limitation to distinguish it from prior art polyvinyl alcohol-based polyamide membrane. Claim 1, as amended, is definite and enabling because one skilled in the art would be able to make and use the reverse osmosis membrane recited in this claim according to the cross-linking conditions disclosed in the specification. Claims 4-6 depend from claim 1 and should also be patentable for at least the same reason. Because the above amendments render the rejections moot, withdrawal of these rejections is respectfully requested.

IV. Conclusion

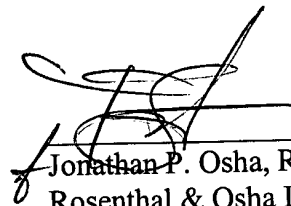
The Applicant believes this reply is responsive to every issue raised by the Examiner in the Office Action dated August 1, 2002. The claims are shown to be patentable over the prior

art. The Applicant respectfully requests favorable action in the form of a Notice of Allowance.

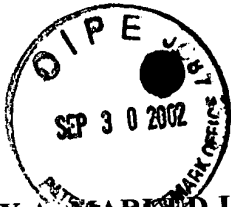
Please apply any charges not covered, or any credits, to Deposit Account 50-0591
(Reference No. 04558.035002).

Respectfully Submitted,

Date: 9/30/02

 #46,079
Jonathan P. Osha, Reg. No. 33,986
Rosenthal & Osha L.L.P.
1221 McKinney St., Suite 2800
Houston, TX 77010
Telephone: (713) 228-8600
Facsimile: (713) 228-8778

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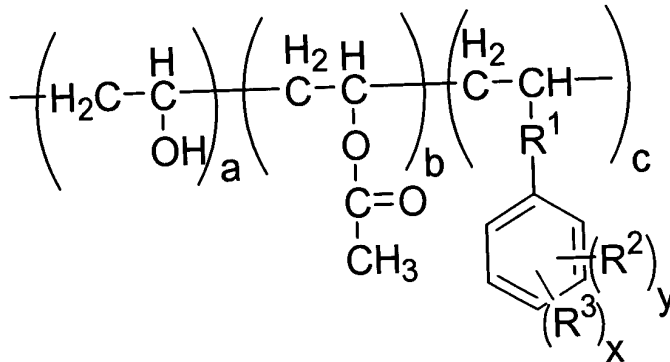
APPENDIX A: MARKED-UP COPY OF THE CLAIMS

1. (Three Times Amended) A highly permeable composite reverse osmosis membrane comprising a thin film and a microporous support to support the thin film;

wherein the thin film is formed by reacting a [(a) component] polyvinyl alcohol-based amine compound having at least two amino groups with [a (b) component, the (a) component, as represented by Formula 1; and the (b) component comprising] at least one substantially monomeric compound having at least two groups that react with the at least two amino groups on the polyvinyl alcohol-based amine compound,

and wherein the the composite reverse osmosis membrane having a salt rejection of no more than 80% as assessed with a pH 6.5 aqueous solution comprising 500 mg/liter of sodium chloride at an operation pressure of 5 kg/cm² and at a temperature of 25 °C.

[Formula 1



wherein $0 < a$, $0 \leq b$, $2 < c$, $1 \leq x \leq 5$, $0 \leq y \leq 4$, C-R¹-C is at least one group selected from the group consisting of an ether group, an alkylene group, and an ester group; R² is at least one group selected from the group consisting of an alkyl group and a halogen group; and R³ is NH₂.]

4. (Twice Amended) The highly permeable composite reverse osmosis membrane according to claim 1, wherein the [(b) component] at least one substantially monomeric compound is an acid chloride.

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5. (Three Times Amended) The highly permeable composite reverse osmosis membrane according to claim 1, wherein the [(b) component] at least one substantially monomeric compound is at least one polyfunctional acid [chloride] halide compound selected from the group consisting of aromatic, aliphatic, and alicyclic polyfunctional acid halide compounds.